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BY

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REPRINTED FROM

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES,

MAY, 1889.

ELECTROLYSIS.

PROPER AND IMPROPER METHODS OF USING IT IN THE REMOVAL OF HAIRS AND KINDRED OPERATIONS.

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It might seem as if the last word had been said for the removal of hair by electrolysis, and yet daily experience convinces me that much more remains to be said. The operation as ordinarily performed leaves scars of greater or less magnitude, and as long as this is the case the operation is not a complete success. All writers that I have read admit that scars necessarily follow the operation. Fox, White, Amory, Hardway, Duhring, and Jamison make this admission. The writer confesses to having formerly expected similar results. It is true that the magnitude of these scars varies inversely with the skill of the operator, and it is possible that in the hands of an experienced operator like any of those just mentioned, they may be reduced to a minimum of disfigurement.

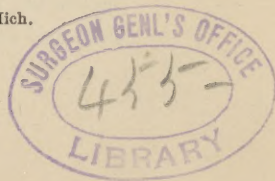
"If the operation is very skilfully performed," says Fox, "it ought not to leave scars *as a rule*." In some cases it is impossible to prevent the production of minute punctate cicatrices, which, however, can only be seen on close inspection." As a result of still further experience he says:

"Without the requisite skill, which comes only from practice, an unnecessary amount of pain is usually inflicted upon the patient; a considerable degree of inflammation of the skin is occasioned; disfiguring scars are apt to be produced, and a large proportion of the hairs operated upon are apt to return; but when the operation is properly performed the pain is slight, the inflammatory reaction is scarcely noticeable, no *disfiguring*¹ scars result, and the permanent removal of the hair is assured." "In the majority of cases it is possible to remove hair from the face without leaving any permanent mark, but unless an unusual amount of care is exercised a number of faint punctate cicatrices may sometimes be left as a result of the operation. But these are usually insignificant, being only apparent upon a very close inspection of the skin in a good light, and they are rarely thought worthy of consideration by the patient who is rejoicing over the permanent removal of the hairs."²

But every one has not the experience and consequently cannot acquire the skill of the author quoted. Though in his skilful hands the operation may not result in greater blemishes than he describes, in the hands of others with less experience it does result in unsightly disfigurement, as he himself points out. The fault lies, I am satisfied, in imperfect methods, insufficient apparatus, and erroneous notions of electro-physics, rather than in the personnel of the operators; and though Dr. Fox and

¹ Italics not in original.

² The Use of Electricity in the Removal of Superfluous Hairs. Detroit, Mich.



a few others may be able to compensate by great skill and experience for such insufficient apparatus and faulty methods, to others less skilful, but yet ambitious to perform the operation, this is not vouchsafed. And after all, the "minute cicatrices" described are blemishes and undesirable, even though not complained of by grateful patients.

An illustration of the unfortunate results of the operation was forced upon the writer's attention recently in the person of a very handsome young woman whose marked beauty was marred by the unsightly scars which appeared, at first sight, to have been smallpox, but closer observation showed they had been artificially made by electrolysis. When it is remembered that with proper precautions and with proper apparatus these scars were *entirely unnecessary*, one can understand the gravity of the accident that caused them.

That this disfigurement of the face by unsightly scars is no infrequent accident a little observation in the street will satisfy any one for himself. Certainly the experience of the writer enables him to see numerous patients who have been thus disfigured.

The purport of this paper is to emphasize the value of certain methods of using electrolysis in order that the best results may be obtained.

Continued experience has demonstrated to me that when one can operate under his own conditions scars, even minute cicatrices, are absolutely unnecessary.

The principal reasons for disfigurement of this kind are either, first, unnecessarily strong currents; or, second, currents of unnecessarily long duration. The first, when not intentional, is due to either, *a*, not using suitable means for measuring the current; or, *b*, not using suitable apparatus to insure a definite current of a constant, pre-determined strength.

In a paper published in the *Boston Surgical and Medical Journal*, November, 1886, I called attention to the necessity of always using an absolute galvanometer in the circuit. In this paper the fact was pointed out that with the apparatus usually employed the strength of the current varied immensely, sometimes fivefold during the course of a sitting, owing to variations in the wetness or dryness of the electrodes, the amount of pressure with which they were applied, etc., and to recognize these oscillations in the current an absolute galvanometer was necessary. So far as the use of the galvanometer is concerned, I have little to add to what was said then.

To use electrolysis without one at this date seems little less than inexcusable blundering, though I am surprised to find little or no reference to such an instrument in works on dermatology. To neurologists who are familiar with the use of electricity, the neglect to use a galvanometer by those who use electrolysis seems incomprehensible. What was said in the paper just referred to regarding the possibility of avoiding scars by this means has been confirmed by the continuous experience of the writer; but care and watchfulness are required. I have, though, to modify somewhat

what was said regarding the maximum of strength and duration of current to be used. Since then, with a view to maintaining a current at any desired strength without oscillation, I have adopted a method which completely fulfils this object. It consists in using a powerful battery (80 to 100 cells) of high electro-motive force, with a high resistance introduced into the circuit, instead of the usual weak battery (10 to 15 cells) with low electro-motive force.

That is to say, as the operation is usually performed, a battery of 10 to 15 cells is used. If these be of the zinc-carbon variety (say a Leclanché battery), and supposing the resistance of the body to be 3000 ohms and neglecting the resistance of the battery, 10 cells would give a current of 5 milliamperes—an unnecessarily strong current in my opinion.

By the method which I have adopted the same current may be obtained, but with many advantages. Suppose instead of 10 we use 100 chloride of silver cells (equivalent to about 70 Leclanché), and introduce by means of a rheostat a resistance of 20,000 ohms into the circuit. A current now will be obtained of 5 milliamperes as before, but it will have the great advantage over the former current of being of constant strength and practically without variations, an advantage which a little consideration will show to be of inestimable value.

The strength of current is determined by the formula $C = \frac{E}{R}$, where E =electro-motive force of battery and R is the resistance of battery and outside circuit. Now when 10 zinc-carbon cells are used, the "current strength" $C = \frac{15}{3000} = .005$ or 5 ma.

If now, by chance, the electrode and skin have become dry, as frequently occurs during the course of a sitting, the resistance may increase to 5000 ohms or more, reducing the current to 3 ma. If again the skin becomes hyperæmic and the electrodes are freshly moistened, the resistance may be reduced from 5000 to 1000 ohms, and with this the current jumps up to 15 milliamperes, a current capable of disfiguring the skin beyond repair. When, however, the second method (the one here advocated) is adopted we have an absolute safeguard against this accident. Now, as will be seen at once by reference to the formula, $C = \frac{100}{20,000 + 3000} = .0043$ or 4.3 milliamperes; 20,000 ohms being the resistance of the rheostat and 3000 that of skin and electrodes.

If the resistance of the body and electrodes, for reasons just given, should diminish to 1000 ohms or increase to 5000 ohms, the current would be only increased or diminished to 4.7 and 4 ma. respectively, an insignificant variation of 0.4 ma. Even this small variation would be still further reduced, if instead of using a current of 4 to 5 ma., we use, as is far better, a current of from 1 to 3 ma., with a rheostat resistance of from 30,000 to 100,000 ohms.

On the ground of comfort and convenience to the operator alone, the use of powerful batteries with high resistance is such an advantage that any one who has once used this mode will never give it up.

One has only to measure his current by the galvanometer before applying it to the body, regulate it to the desired strength, and then apply it with the full confidence that it will remain at a constant strength throughout the sitting whatever be the condition of the skin—whether relatively dry or wet. One can thus measure out beforehand the exact strength of current to be used as accurately as the druggist weighs and measures the ingredients of a prescription, an advantage that must be apparent on the face of it.

The apparatus I use consists of a fifty cell Barrett chloride of silver battery (the best battery yet invented for this purpose) connected with a subsidiary carbon-zinc battery of equal electro-motive force, and in the circuit are inserted the rheostat and galvanometer. A large electrode covered with absorbent cotton serves for the application of one pole to the forearm. A chafing dish with a gas lamp at hand furnishes a constant supply of hot water for application to the face during and after the sitting. This largely prevents secondary inflammation. Before the needle is inserted the current is first regulated by the rheostat to any desired strength, the poles being put in contact outside the body, after which the electricity may be applied with confidence and without attention to the galvanometer. What would we think of a druggist who dispensed his prescriptions without scale or graduate, and merely guessed at the quantity prescribed? and yet any one who performs electrolysis without such apparatus as I have described, at least without a galvanometer, does practically this—he merely guesses at the strength of current, used and often with disastrous results.

By the use of a galvanometer, alone, one can accurately measure the current, and, by breaking the circuit when oscillations in its strength occur, guard against them; but these oscillations cannot be prevented from occurring if only a few cells are used. With care, however, disfigurement can be prevented. It is in the ease and certainty with which a current can be maintained at any desired strength that batteries of high electro-motive force, combined with a high-resistance rheostat, have such an advantage.

The second cause of disfigurement is the use of currents of too long duration, but as the time element is dependent upon the strength of current employed, it cannot be governed by any apparatus, but must be left to the individual experience of the operator, who will be governed by the fineness or coarseness of the hairs and the strength of current employed. But supposing we are able accurately to measure and regulate our current, what strength of current shall we use? This is not an easy question to answer, so much depends upon the condition present

in each case. I have elsewhere stated that the strength should be not less than one-half nor more than two ma., but further experience convinces me that it is not always desirable to restrict the strength to such narrow limits, and in one respect it is probably difficult to do so, for no two galvanometers record exactly the same measurements, and a current which is given as 1 ma. by one may appear as 2 ma. on another. Furthermore, the greater the skill and experience of the operator the stronger the currents he can use with impunity. The advantage of the stronger currents is that the hairs can be removed with greater rapidity and surety. I may say I never now exceed 3 ma., as measured on my own Hirshmann galvanometer, and that only with very strong coarse hairs, and do not believe this strength should ever be exceeded. On the upper lip I never exceed 1 ma. But as much depends on the duration of the current as upon the strength, fifteen to twenty seconds being the extreme limit of duration, while three to five seconds may suffice, according to the strength of the current; but this must be determined in each case by the judgment of the operator. The operation may be compared to photography. Just as experience alone can enable a person to determine the strength of light and the time of exposure suitable in any given case, so, with electrolysis, experience alone can teach the strength and duration of currents to be used, though in both cases there are limits that should not be passed. The finer the hairs, the feebler and shorter the current that can be used; and the stouter the hairs, the stronger and longer the current required; but the weaker and shorter the current, the less liability of resulting scars.

I am free to admit that with these mild currents that I advise the liability of return of the hairs is greater than with stronger and longer continued currents, especially when the hairs are coarse. I admit that with such more hairs return than with the latter current, but a guaranty against the return of the hairs is only one and not the principal object to be sought. Those that return can be done over again. The most important desideratum is not a diminution of the percentage of the hairs that return, but *security against disfigurement*, and this can only be obtained by the employment of some such methods as I have advocated.

I also admit that there are patients to whom a small bill and time are of more importance than scars. The necessities of some compel them to accept the latter evil; to such I am in the habit of giving the choice of method, explaining that they can have the hair removed rapidly with the chance of scarring, or more slowly without such danger. I think no one will deny that a person has the right to demand that the operation be done in the best possible way, and that the opportunity be at least offered of having the chances of disfigurement reduced to a minimum, even though these be limited to "punctate cicatrices."

I cannot forego saying a word on the subject of the so-called quantity batteries and "quantity" currents, as it is a source of much misunder-

standing, even with otherwise expert medical electricians. Many writers insist upon the use of batteries arranged for quantity (that is, with large plates and small internal resistance, or connected "for surface" instead of "in series") with the idea that the current from such a battery is less painful and more efficacious. The absurdity of this proposition will be apparent to any one who reflects upon the meaning of electrical units. To compare the currents from two batteries we must, of course, compare currents of the same strength, say 1 ma. Now a current of 1 ma. means the quantity of one milliweber of electricity flowing through a given conductor in each second of time, just as we would speak of the strength of the current of a stream of water being indicated by the quantity of water flowing in each second of time, as one gallon per second; or a cubic foot of gas per hour. Now to say that a milliweber of electricity per second from a "quantity battery" differs from a milliweber per second from an "intensity battery" flowing through the *same conductor*, is equivalent to saying that a current of a gallon of water per second from a large reservoir differs from a current of a gallon of water per second from a smaller reservoir placed at a greater height and flowing through the *same sized pipe*. If, as is said, the *force* or *intensity* of the stream is greater in the latter case than in the former, then, as the size of the pipe is the same, more than a gallon of water must flow per second, and in the case of the electricity more than one milliweber per second. In short, a milliampère of electricity means a given *quantity* per unit of time, and so long as you do not change that quantity the form of the battery is without effect. To say otherwise is much like saying that feathers weigh more than lead.

But there is one truth underlying this notion of quantity batteries, and this is, that a given number of cells connected "for surface," give, *when applied to the body*, a *weaker* current than the same number of cells connected "in series," consequently the pain of course is less, and those who recommend such batteries are unconsciously recommending what has been advocated here, namely, weak currents, only without the advantages of constancy.

In the preceding discussion reference has been made entirely to the use of electrolysis in removing hair; but it must be apparent that the same principles hold good for all other uses to which electrolysis may be put, when comparatively weak currents are employed. In operating upon vascular tumors of the skin, moles, *nævi*, strictures of the urethra, and removal of ingrowing eyelashes, the same methods should be employed. I cannot help thinking that the diverse results obtained by different experimenters in operating on urethral stricture may be accounted for by the faulty methods employed. When high currents are necessary, as in uterine fibroids, small oscillations are of no importance, and a galvanometer only is necessary.

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